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Sub-Committee of Experts on the Transport of Dangerous Goods

Fifty-third session
Geneva, 25 June-4 July 2018
Item 10 (e) of the provisional agenda
Issues relating to the Globally Harmonized System of Classification and Labelling of Chemicals: joint work with the GHS Sub-Committee

Sub-Committee of Experts on the Globally Harmonized System of Classification and Labelling of Chemicals

Thirty-fifth session
Geneva, 4-6 July 2018
Item 3 (b) of the provisional agenda
Classification criteria and related hazard communication: review of Chapter 2.1

Outline for a potential amended classification system for explosives in the GHS

Transmitted by the expert from Sweden*

Background

1. Since 2015 work has been on-going to revise Chapter 2.1 of the GHS, which is the chapter containing the classification and labelling provision for explosive substances, mixtures and articles (Explosives). The work is done within an Informal Correspondence Group (ICG) which currently consists of almost fifty experts, and is led by the expert from Sweden[1]. The progress of the work has continuously been reported to the Sub-Committee of Experts on the GHS (SCEGHS) and the Sub-Committee of Experts on the Transport of

* In accordance with the programme of work of the SCEGHS for 2017–2018 approved by the Committee at its eighth session (ST/SG/AC.10/C.4/64, paragraph 67, and ST/SG/AC.10/44, paragraph 14).

[1] See section III, sub-section A, of the report from the twenty-ninth session of the Sub-Committee of Experts on the Globally Harmonized System of Classification and Labelling of Chemicals, ST/SG/AC.10/C.4/58.

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Dangerous Goods (SCETDG)[2]. According to the Programme of Work for the group[3], the work is set to be completed during the current biennium.

2. In the latest status report on the work[4] an amended classification system for Explosives in the GHS was described, which was also presented at the (thirty-fourth sessioin) meeting of SCEGHS. Discussions within the ICG have circulated around a modified classification system for some time now, although there is hesitation from some ICG-members on the need for such a radical change and concerns as regards potential downstream consequences. While it is recognised that opinions are still divided within the ICG – on the idea as such as well as on many details – this paper presents the outline of the amended system to the Sub-committees. This paper is presented by the expert from Sweden in his capacity as leader of the ICG. He has however tried to take account of most comments from the ICG when a draft of this paper was circulated.

Description of the problem

3. The main reason for the review of Chapter 2.1 is that the current classification and labelling system poses difficulties when it comes to Explosives that are not packaged or configured for transport.[5] The background to this is that the GHS adopted the classification system used in the Model Regulations on the Transport of Dangerous Goods (Model Regulations) to classify Explosives, which relies on them being packaged or configured for the purpose of transportation. The particular packaging or configuration can be decisive for the classification as it may be designed to mitigate the explosive effects of the substance, mixture or article, for safe transportation. The explosive behaviour of the substance, mixture or article may thus be different (more severe) outside of this packaging/configuration, but the current GHS system is not capable of reflecting this.

4. The GHS is a system for classification and labelling of chemicals which could be applied to a variety of situations, such as supply, use, manufacturing, processing, storage, and transport. A classification that depends on a certain packaging or configuration, e.g. that for transport, cannot comfortably be used for situations where that packaging or configuration doesn't exists. So while the current classification system for Explosives can appropriately classify explosive substances, mixtures and articles as packaged or configured for transport, it is often difficult to apply whenever they are not in this packaging or configuration.

5. A dubious GHS classification may, in turn, lead to inaccurate hazard communication, as e.g. reflected on the GHS label or in GHS safety data sheets. (This may for instance lead to detonating articles such as blasting caps being labelled in the same way as very minor consumer fireworks such as sparkles.) Misleading hazard communication may obviously constitute a safety concern through insufficient safety measures being taken upon handling the Explosive in question. The difficulties of the current GHS system to classify and appropriately communicate the hazard of explosives that are not packaged/configured for transport constitutes the core of the problem that the ICG has been trying to tackle.

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[2] See informal documents INF.10 (GHS, thirty-fourth session) - INF20 (TDG, fifty-second session), INF.7 (GHS, thirty-third session) - INF.15 (TDG, fifty-first session), INF.8 (GHS, thirty-second session) - INF.11 (TDG, fiftieth session), INF.10 (GHS, thirty-first session) - INF.37(TDG, forty-ninth session), INF.9 (GHS, thirtieth session) - INF.32 (TDG, forty-eighth session).

[3] See informal document INF.13 (GHS, thirty-third session) - INF.44 (TDG, fifty-first session) and section III, sub-section B of the report from the thirty-third session of the SCEGHS, ST/SG/AC.10/C.4/66.

[4] Informal document INF.10 (GHS, thirty-fourth session) - INF20 (TDG, fifty-second session).

[5] See also the initiating paper from the expert from Australia, ST/SG/AC.10/C.3/2014/79–ST/SG/AC.10/C.4/2014/15.

Potential solution - a new layer of classification

6. The ICG has discussed how to resolve the problems described above. Since the autumn of 2016, these discussions have revolved around a possible amended classification system for Explosives in the GHS. However, as the current Division-based system performs well for Explosives in a transport packaging or configuration, and is widely used in regulations also beyond transportation (such as storage), the ICG acknowledges the need for the (transport) Divisions, to be retained in the classification system. Another agreed prerequisite for any amended classification system is that it doesn't extend the scope of the current hazard class of Explosives, and that no new mandatory testing is introduced.

7. To provide a solution that can fit the needs described within the boundaries stated, the ICG has lately considered a classification system that amends the existing one by adding a layer of differentiation that is independent of the (transport) packaging or configuration. This gives a new dimension of flexibility in that a choice can be made of whether to refer to the Divisions used to classify Explosives in their (transport) packaging/configuration or whether to refer to a classification that is independent of that parameter, e.g. for some regulatory purposes. The system that the ICG is currently refining has this characteristic:

GHS Category	**1**	**2**		
GHS Sub-category	*Not applicable*	**2A**	**2B**	**2C**
Transport classification	*Not applicable*	Class 1 (any Division)		

8. In this system, all Explosives that have been assigned a Division in accordance with the classification procedure of the Model Regulations belong to Category 2, which is therefore identical in scope to Class 1 of transport and provides straight-forward consistency between the GHS and the Model Regulations. Within this Category 2, however, Explosives are differentiated according their hazardous behaviour regardless of any particular (transport) packaging or configuration. The Sub-categories 2A, 2B and 2C within Category 2 represents a high hazard, medium hazard and low hazard, respectively, and are thus organised in the normal GHS-fashion (which the Divisions are not). While still subject to discussion, criteria for these Sub-categories were tentatively agreed when the ICG met in December 2017[6], which are displayed in Annex 1 to this paper. Some later amendments suggested in correspondence within the ICG have also been included.

9. Category 1 of the system contains Explosives that have not been assigned a Division. The reason for this can be that they are not packaged/configured for transport or that they are considered too dangerous to transport and hence are rejected from Class 1 of transport (the latter termed "Unstable explosives" in the current GHS system). It should be emphasised that Category 1 is intended to only comprise substances, mixtures and articles that belong to the current GHS hazard class of Explosives – no change in scope of the hazard class as such is thus intended. The draft criteria of Category 1, as discussed within the ICG, to accomplish this are displayed in Annex to this paper. With Category 1 a way is thus opened for classification of Explosives not in the (transport) packaging/configuration, which currently doesn't exist in the GHS.

10. By using the (sub-)categories of the classification system as outlined above as the basis for GHS hazard communication, the dependence on particular (transport) packagings/configurations can be avoided. This allows the hazard communication to describe

[6] See informal document INF.20 (GHS, thirty-fourth session) – INF.57 (TDG, fifty-seventh session).

the effect of an explosive substance, mixture or article independent of that (variable) parameter. While the ICG has not yet come to a consensus on all the hazard communication elements, the following table represents the suggestion around which the discussions have revolved lately:

Category	**1**	**2**		
Sub-category	*Not applicable*	**2A**	**2B**	**2C**
Division (for transport[7])	*Not applicable*	1.1, 1.2, 1.3, 1.4, 1.5 or 1.6	1.4 *(subject to further criteria)*	1.4 *(subject to further criteria)*
Symbol[8]	Exploding bomb	Exploding bomb	Exploding bomb	*No symbol*
Signal word	Danger	Danger	Warning	Warning
Hazard statement	*To be determined*	Explosive	Fire or projection hazard	Fire or projection hazard

11. As displayed in the table above, Explosives in Sub-category 2A would be assigned the hazard statement "Explosive" regardless of their Division for transport. This is unlike the current GHS-classification system where the hazard statements are tied to the Divisions, and hence to the explosive behaviour in the (transport) packaging/configuration. Only Explosives in Sub-categories 2B or 2C would be assigned the less severe hazard statement "Fire or projection hazard", as for these the explosive hazard is not deemed "high" regardless of any particular packaging/configuration. In this way the current situation where a "high hazard" Explosive may escape more severe hazard communication due to its (transport) packaging or configuration is avoided.

12. An effect of the above is, naturally, that the (transport) Division cannot be read from the GHS-label (which it currently indirectly can via the hazard statement), and the ICG has discussed how this information could be inserted. One suggestion would be to use a precautionary statement for this, e.g. by amending the already existing P234 to read "Keep in original package. [Division ... as originally packaged/configured for transport.]" This precautionary statement, including the text in square brackets, would be applicable to all Explosives in Category 2, together with appropriate conditions for use ("..." is where the number of the Division for transport is to be inserted). This idea needs further consideration though, and also other options to accomplish the same effect are under discussion.

Summary and action

13. The introduction of the amended GHS-system for classification and labelling as outlined in this paper would solve the problem of classification of Explosives that are not in a (transport) packaging or configuration as well as remove the dependency of the GHS hazard communication on that packaging/ configuration. While it does constitute a major change to the current system it retains the currently used (transport) Divisions, and downstream regulations relying on this classification can continue to use it as a basis also in the future.

14. While the amended GHS system for classification and labelling of Explosive developed by the ICG is not yet sufficiently ripe for a sharp proposal for changes to GHS Chapter 2.1 to be made, it is now in a stage where discussions in the ICG revolve around perfecting it rather than about the principle as such. With reference to the Programme of Work, the expert from Sweden therefore believes this is an appropriate time to invite the Sub-committees to discuss whether a new system as outlined above could in principle be an acceptable way to resolve the current problems of Chapter 2.1, recognising that the details still remain to be worked out.

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[7] Views are divided within the ICG on whether a Division in principle can also be assigned in other situations than in the transport packaging or configuration.

[8] It is recognised that other symbols are used for Divisions 1.4, 1.5 and 1.6 for transport, according to the Model Regulations. No changes to these are intended.

Annex

Tentative criteria for an amended GHS classification system for Explosives (under development)

Texts in normal font are the tentatively agreed criteria as presented in INF.20 to the 34th session of the SCEGHS (INF.57 to the 52nd session of the SCETDG), including provisional criteria from then in square brackets. Later correspondence within the ICG has resulted in refined criteria for Category 1 which are shown in italics. Italic text in square brackets are other suggestions from ICG-members that have not been further evaluated yet.

Category	1	2
Criteria	*Substances, mixtures and articles which:* *- are manufactured with the intention of producing a practical explosive or pyrotechnic effect; or* *- are substances or mixtures that give positive results in Test series 2; or* *- [are articles that give positive results in Test series 4; or]* *- are [candidates for] ANE that give positive results in Test 8(a).* *unless they* *- meet the criteria for a Division within ~~Class 1 for transport~~ the class of explosives according to the Manual of Tests and Criteria; or* *- are substances or mixtures not manufactured with the intention of producing a practical explosive or pyrotechnic effect which are excluded from this hazard class by results in Test series 6; or* *- are articles excluded by definition in 2.1.1.2(b); or* *- are [candidates for] ANE that give negative results in Tests 8(a) - (c).*	Substances, mixtures and articles which meet the criteria for a Division within ~~Class 1 for transport~~ *the class of explosives according to the Manual of Tests and Criteria.*

Sub-category	2A	2B	2C
Criteria	Substances, mixtures and articles not meeting the criteria for Sub-categories 2B or 2C.	Substances, mixtures and articles meeting the criteria for Division 1.4, Compatibility group* C or G, according to the Model Regulations and where: - there is no indication that the packaging is designed such that the hazard is reduced, e.g. no special packing instructions/criteria required, and no special orientation or dividers required to pass Test series 6 as Division 1.4, and - there is no violent reaction in Test 6a or 6b without mass explosion; and - [for unintentional explosives possible further criteria based on data from other tests.]	Substances, mixtures and articles meeting the criteria for Division 1.4, Compatibility group* S, according to the Model Regulations and where: - there is no indication that the packaging is designed such that the hazard is reduced, e.g. no special packing instructions/criteria required, and no special orientation or dividers required to pass Test Series 6 as Division 1.4, Compatibility group* S; and - there is no violent reaction in Test 6a or 6b without mass explosion; and - [for articles, the individual article or the smallest inner packaging unit fulfils the criteria of Division 1.4, Compatibility group* S, according to Test 6(d); and] - [for unintentional explosives possible further criteria based on data from other tests; and] - *[the explosive is Compatibility group* C or G outside of the packaging.]*

* Compatibility groups are defined in Chapter 2.1, section 2.1.2, of the Model Regulations.

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Sub-Committee of Experts on the Transport of Dangerous Goods

Fifty-third session
Geneva, 25 June-4 July 2018
Item 10 (b) of the provisional agenda
Issues relating to the Globally Harmonized System of Classification and Labelling of Chemicals: testing of oxidizing substances

Sub-Committee of Experts on the Globally Harmonized System of Classification and Labelling of Chemicals

Thirty-fifth session
Geneva, 4-6 July 2018
Item 3 (a) of the provisional agenda
Classification criteria and related hazard communication: work of the Sub-Committee of Experts on the Transport of Dangerous Goods (TDG) on matters of interest to the GHS Sub-Committee

Tests for oxidizing liquids (Test O.2) and oxidizing solids (Tests O.1 and O.3): Consequential amendments of cellulose replacement to test descriptions

Transmitted by the expert from France*

Introduction

1. During its eighth session, the Committee approved the programme of work of its two sub-committees for the biennium 2017-2018 (see ST/SG/AC.10/44, para 14; ST/SG/AC.10/C.3/100, para 98; ST/SG/AC.10/C.4/64, annex III). This programme of work includes among issues relating to the GHS, testing of oxidizing substances.

2. This programme of work will focus on consequential amendments to Test O.1 to O.3 as a follow-up of the replacement of cellulose as agreed by the Committee (see

* In accordance with the programme of work of the Sub-Committee for 2017-2018 approved by the Committee at its eighth session (see ST/SG/AC.10/C.3/100, paragraph 98 and ST/SG/AC.10/44, para. 14)

ST/SG/AC.10/44, para 11 and /Add. 2, section 34; ST/SG/AC.10/C.3/100, para 79-82; ST/SG/AC.10/C.3/64, para 14).

3. The calendar for the development of the consequential amendments to Test O.1 to O.3 as a follow-up of the replacement of cellulose indicated by the expert from France in ST/SG/AC.10/C.3/2017/28 has been applied.

4. An overview of the progress of work was given in ST/SG/AC.10/C.3/2017/45 and informal document INF.35 (fifty-second session) as well as first proposals for amendments of the test descriptions for oxidizing liquids (Test O.2) and oxidizing solids (Test O.1 and O.3).

Results of the programme of work

5. The following paragraphs give the results of the work carried out for the four items identified for consideration (see informal document INF.12 (fifty-first session)) in the programme of work.

6. For the improvement of Test O.2, it was first considered the possibility of replacement of the reference substances for allocation of packing group (PG) II (i.e. 40% aqueous sodium chlorate solution) and of PGIII (i.e. 65% aqueous nitric acid) by diluted aqueous solutions of perchloric acid[1] in the range of 30-40%. Preliminary promising results were presented by the French National Institute for Industrial Environment and Risk (INERIS) to other laboratories in September. Although most of the laboratories expressed their sympathy for the idea of replacing three reference substances by only one in the test method, it was also recognized that this operation will required additional work and a longer time frame before it can be validated through Round Robin Tests (RRT).

7. Secondly it was considered to improve the wording of the test description, in particular of the section 34.4.2.3 of the Manual of Tests and Criteria, (ST/SG/AC.10/11/Rev.6). For that a questionnaire was circulated between the nine laboratories that participated to a RRT (see informal document INF.47 (forty-ninth session) annex 1) on Test O.2 in 2015 to collect details of their best practices. Feedback gained from their answers and other communication allow to make a proposal (see para 13 of this document).

8. The reference oxidizer (i.e. calcium peroxide 75%) for Test O.3 may originate from different sources and is subject to ageing. Therefore, the question of the necessity of a determination of the concentration in calcium peroxide prior using the reference oxidizer was investigated. It was judged that making this determination mandatory prior to each testing campaign would increase the level of complexity of Test O.3 methodology, require further interlaboratory studies and create an unnecessary burden. It was considered that the quality of the calcium peroxide shall be based on the certificate of analysis from the supplier and its date of expiry. It was also recognized that the tolerance given for the concentration of calcium peroxide as specification could be changed with no impact on the outcome of the test and that will extend the period of usage of calcium peroxide according to the actual specifications of the suppliers. See corresponding proposal in para 14 of this document.

[1] A 50% aqueous solution of perchloric acid is already the reference substance for allocation of PGI

9. Requirements in Test O.3 description (see section 34.4.3.5.3 of the Manual of Tests and Criteria ST/SG/AC.10/11/Rev.6) are set for the coefficient of correlation R2 (i.e. at least 0.95) and the standard deviation (i.e. not exceeding 10%). From a practical point of view, to respect the strictness of these criteria has for consequence the necessity to repeat burning trials a very numerous time before both criteria can be met at once.

10. Following a RRT on Test O.3 (see informal document INF.47 (forty-ninth session) annex 2) and analysis of its results, these criteria were, indeed, seen to be too limiting by the majority of the thirteen participating laboratories. The impact and consequence of a possible relaxation of these criteria were studied based on test results gained during the hereinbefore RRT. The study showed that no significant alteration of the overall results (i.e. classification of the tested substances) were noticeable in the case where the criteria are changed from "at least 0.95" to "at least 0.90" for the coefficient of correlation R^2 and from "not exceeding 10%" to "not exceeding 20%" for the standard deviation. See corresponding proposal in para 15 of this document.

11. During Test O.3 in some cases breakage of the wire during the runs is observed see for illustration the RRT report detailed in informal document INF.47 (forty-ninth session) annex 2, para 2.5.1.1. The possible reasons of these breakages were explored in more details by France. It is known from the literature[2] that this issue is more frequent with nitrate compounds or with low melting point samples. In this latter case, the melted portion of the sample may fuse to the ignition wire and the fused portion possibly reaches a temperature higher than the melting point of the ignition wire. Different natures of ignition wires are already used by the different laboratories. Information on the performance of these wires are available in a published RRT report and can be used as guidance for the selection of a wire on a case by case based on the laboratory experience. Based on that it is seen not necessary to change the specifications given in section 34.4.3.3.2.

12. For Test O.1 which is similar in principle to Test O.3, the wording for the metal wire description in 34.4.1.2.3 can be aligned with the text in 34.4.3.3.2 to benefit from the work achieved during the development of Test O.3. See corresponding proposal in para 16 of this document.

Proposals for amendments

13. In the following proposals, new text is underlined and deleted text is ~~struck out~~.

Proposal relating to Test O.2 – improved wording

14. Modify the text in the Test O.2 description, i.e. in section 34.4.2.3.1 of the Manual of Tests and Criteria, ST/SG/AC.10/11/Rev.6, as follows:

> "34.4.2.3.1 The apparatus, assembled complete with pressure transducer and heating system but without the bursting disc in position, is supported firing plug end down. A leakage test should be conducted on an empty vessel beforehand. 2.50 ± 0.01 g of the liquid to be tested is mixed with 2.50 ± 0.01 g of dried cellulose in a glass beaker using a glass stirring rod or any other appropriate mixing tool for at least two minutes. The time for mixing should be tracked by a timer and kept uniform for all mixtures. **For safety, the mixing should be performed with a**

[2] Hiroshi Koseki in Journal of Loss Prevention in the Process Industries 14 (2001) 431–434

safety shield between the operator and mixture. (If the mixture ignites during mixing or filling, no further testing is necessary.) The mixture is added, in small portions with tapping, to the pressure vessel making sure that the mixture is packed around the ignition coil and is in good contact with it. It is important that the coil is not distorted during the packing process and should be covered completely by the mixture after loading. The bursting disc is placed in position and the retaining plug is screwed in tightly. The charged vessel is transferred bursting disc uppermost to the firing support stand, ~~bursting disc uppermost~~, which should be located in a suitable, armoured fume cupboard or firing cell. The power supply is connected to the external terminals of the firing plug and 10 ± 0.5 A applied. The electric power is set before loading the vessel and should remain fixed for each test sequence or until any breakage of the wire occurs. The time between the start of mixing and switching the power on should ~~be about 10 minutes~~ be as short as possible and be kept constant for each test series.

Proposal relating to Test O.3 – Reference oxidizer

15. Modify the text in the Test O.3 description, i.e. in section 34.4.3.2.1 of the Manual of Tests and Criteria, (ST/SG/AC.10/11/Rev.6), as follows:

"34.4.3.2.1 Technically pure, finely powdered calcium peroxide with a concentration of 75% ± ~~0.5~~ 1.0% is required as the reference oxidizer. The concentration of impurities such as chlorides or compounds which generate water during combustion should be low, as they may ~~impact~~ affect on the burning behavior of the reference ~~piles~~ mixtures. Calcium peroxide meeting the specification below can be used without further pretreatment.[4]

CaO_2:	75% ± ~~0.5~~ 1.0 %
$Ca(OH)_2$:	20% to 25%
$CaCO_3$:	0% to 5%
Chloride:	max 500 ppm
Particle size:	min 99% < 75 µm, ~~and thereof~~ of which min 50% < 20 µm"

Proposal relating to Test O.3 – Coefficient of correlation, standard deviation of test results and improved wording

16. Modify the text in the Test O.3 description, i.e. in section 34.4.3.5.3 of the Manual of Tests and Criteria, (ST/SG/AC.10/11/Rev.6), as follows:

"34.4.3.5.3 The burning rate (BR) depends on the burning intensity and the amount of cellulose in the mixture. ~~It is therefore~~ For the purpose of this test it is defined as the quotient of 60% of the total amount of cellulose ($m_{cellulose}$) in the conical pile and the main combustion time t_{20-80}. The time t_{20-80} is the time between 20% and 80% of the total mass loss. The total mass loss is the difference in mass before ignition and at the end of the ~~main reaction~~ combustion, defined as the time after which the ~~a~~ rate of mass loss rate of less than 1 g per minute.
The burning rate BR_{20-80} is therefore calculated by the following equation:

$$BR_{20-80} = \frac{0.6 \times m_{cellulose}}{t_{20-80}}$$

where:

BR_{20-80} = burning rate between 20% to 80% in g/s
$m_{cellulose}$ = mass of cellulose in mixture in gram
t_{20-80} = burning time between 20% to 80% of total mass loss in seconds

Five valid tests should be performed with each reference and test substance mixture. The profile of each burning test has to be examined by plotting the mass loss as a function of time. The graph can also be used for decision making and should be used in case of doubt. The coefficient of correlation (R^2) of the mass curve of each burning test should be at least ~~0.95~~ 0.90 between 20% to 80% mass loss, otherwise the burning trial has to be repeated. ~~Five valid tests should be performed with each reference and test substance mixture.~~ The standard deviation of the burning rates within these five tests should not exceed ~~10%~~ 20% in total. If these test quality criteria are not met due to test sample properties, judgement based on previous experience or competence of the person responsible for the classification should take precedence over recommended test criteria."

Proposal relating to Test O.1 – Metal wire description

17. Modify the text in the Test O.1 description, i.e. in section 34.4.1.2.3 of the Manual of Tests and Criteria, (ST/SG/AC.10/11/Rev.6), as follows:

"34.4.1.2.3 An ignition source is required comprising an inert metal wire ~~(e.g. nickel/chromium)~~ connected to an electrical power source ~~and with the following characteristics~~ capable of maintaining the power dissipation specified below. The electrical resistance depends on the wire material[1]. It is recommended to use a nickel/chromium or Aluchrom wire as follows:

~~(a) Length = 30 ± 1 cm;~~
~~(b) Diameter = 0.6 ± 0.05 mm;~~
~~(c) Electrical resistance = 6.0 ± 0.5 Ω/m;~~
~~(d) Electrical power dissipated in the wire = 150 ± 7 W.~~

(a) Length	= 30 cm ± 1 cm;
(b) Diameter	below 1 mm;
(c) Electrical power dissipated in the wire	= 150 W ± 7 W.

The wire should be shaped as in Figure 34.4.1.1.".